



## Executive Summary

## Introduction

In 1957, the Department published Bulletin 3, the *California Water Plan*. Bulletin 3 was followed by the Bulletin 160 series, published six times between 1966 and 1993, updating the *California Water Plan*. A 1991 amendment to the California Water Code directed the Department to update the plan every five years. Bulletin 160-98 is the latest in the series.

The Bulletin 160 series assesses California's agricultural, environmental, and urban water needs and evaluates water supplies, in order to quantify the gap between future water demands and the corresponding water supplies. The series presents a statewide overview of current water management activities and provides water managers with a framework for making water resources decisions.

***The Department's Bulletin 160 series quantifies only California's managed or dedicated water uses—urban, agricultural, and environmental uses. Unmanaged uses, such as the precipitation consumed by native plants, are not quantified.***

While the basic scope of the Department's water plan updates has remained unchanged, each update has taken a distinct approach to water resources planning, reflecting issues or concerns at the time of its publication. In response to public comments on the last update, Bulletin 160-93, the 1998 update evaluates water management actions that could be implemented to improve California's water supply reliability. Bulletin 160-93 analyzed 2020 agricultural, environmental, and urban water demands in considerable detail. These demands, together with water supply information, have been updated for the 1998 Bulletin, which also uses a

2020 planning horizon. However, much of Bulletin 160-98 is devoted to identifying and analyzing options for improving water supply reliability. Water management options available to, and being considered by, local agencies form the building blocks of evaluations prepared for each of the State's ten major hydrologic regions. (Water supplies provided by local agencies represent about 70 percent of California's developed water supplies.) These potential local options are integrated with options that are statewide in scope, such as the CALFED Bay-Delta program, to create a statewide evaluation.

The statewide evaluation represents a snapshot, at an appraisal level of detail, of how actions planned by California water managers could reduce the gap between supplies and demands. The evaluation does not present potential measures to reduce all shortages statewide to zero in year 2020. Such an approach would not reflect economic realities and current planning by local agencies. Not all areas of the State and not all water users can afford to reduce drought year shortages to zero. Bulletin 160-98 focuses on compiling those options that appear to have a reasonable

chance of being implemented by water suppliers, to illustrate potential progress in reducing the State's future shortages.

## Overview of California's Water Needs

Bulletin 160-98 estimates that California's water shortages at a 1995 level of development are 1.6 maf in average water years, and 5.1 maf in drought years. (As described later in the Bulletin, shortages represent the difference between water supplies and water demands.) The magnitude of shortages shown for drought conditions in the base year reflects the cut-backs in supply experienced by California water users during the recent six-year drought. Bulletin 160-98 forecasts increased shortages by 2020—2.4 maf in an average water year and 6.2 maf in drought years. The water management options identified as likely to be implemented could reduce those shortages to 0.2 maf in average water years and 2.7 maf in drought years.

Population growth is expected to drive the State's increased water demands. To put California's population into perspective, about one of every eight U.S.

### Summary of Key Statistics

Shown below for quick reference are some key statistics presented in the Bulletin. Water use information is based on average water year conditions. The details behind the statistics are discussed in Chapter ES4.

|                                 | 1995 | 2020 Forecast | Change |
|---------------------------------|------|---------------|--------|
| Population (million)            | 32.1 | 47.5          | +15.4  |
| Irrigated crops (million acres) | 9.5  | 9.2           | -0.3   |
| Urban water use (maf)           | 8.8  | 12.0          | +3.2   |
| Agricultural water use (maf)    | 33.8 | 31.5          | -2.3   |
| Environmental water use (maf)   | 36.9 | 37.0          | +0.1   |

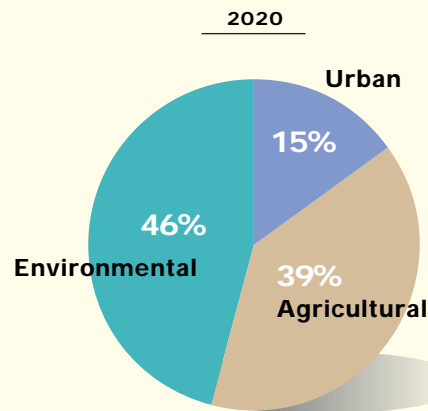
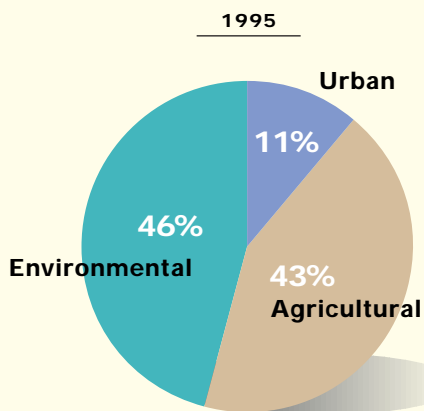
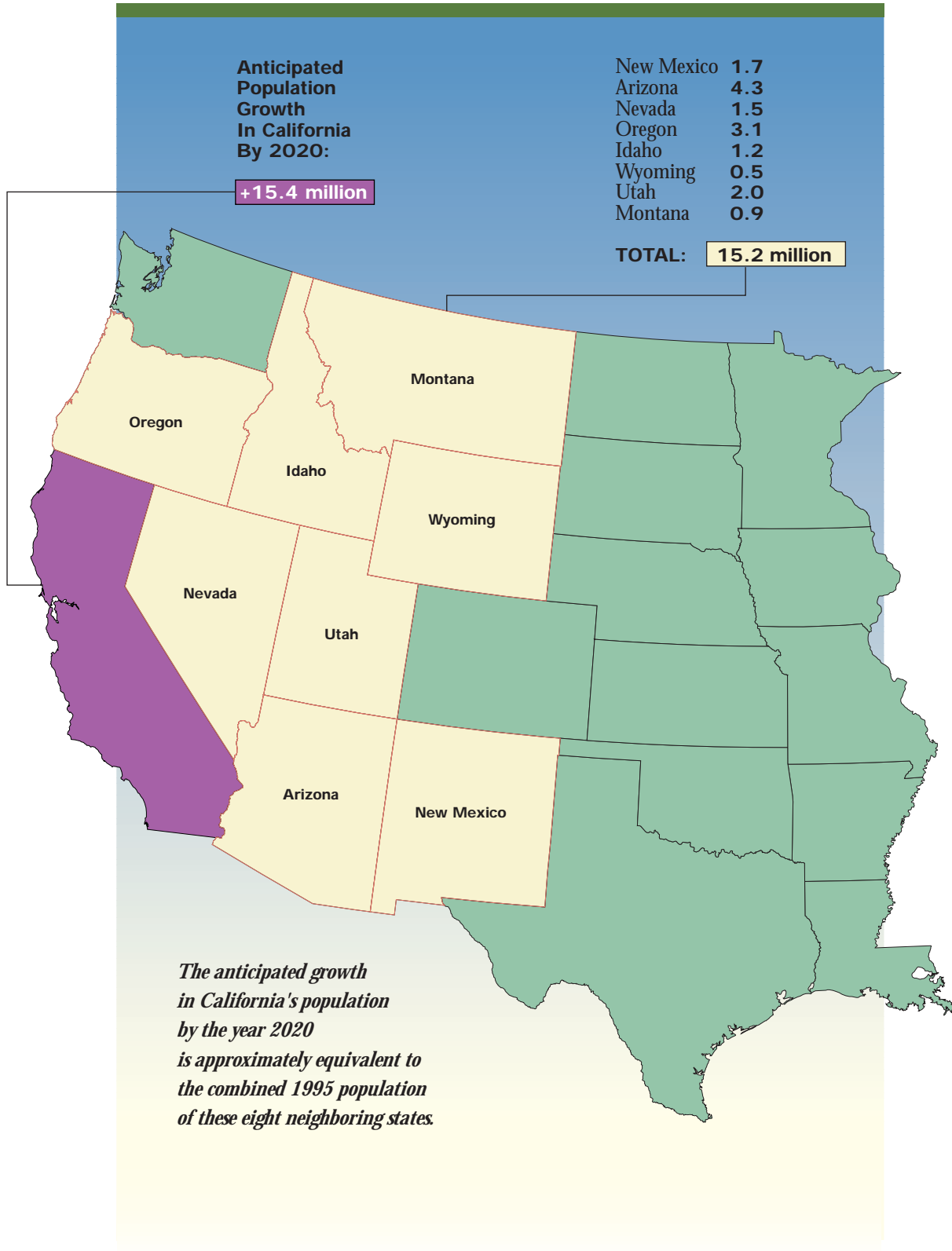


FIGURE ES1-1.

**California's Expected Population Growth Versus Neighboring States' Populations**



residents now lives in California. During the time period covered in the Bulletin (the 25 years from 1995 to 2020), California's population is forecast to increase by more than 15 million people, the equivalent of adding the present populations of Arizona, Nevada, Oregon, Idaho, Montana, Wyoming, New Mexico, and Utah to California, as shown in [Figure ES1-1](#). Today, four of the nation's 15 largest cities (Los Angeles, San Diego, San Jose, and San Francisco) are located in the State.

The [sidebar](#) on page ES1-2 summarizes key statistics developed later in the Bulletin.

## Bulletin 160-98 Hydrologic Regions

[Figure ES1-2](#) shows California's ten [hydrologic regions](#), corresponding to the State's major drainage basins. The Department subdivides the State into regions for planning purposes. The largest planning unit is the hydrologic region, a unit used extensively in this Bulletin. The next level of delineation below hydrologic regions is the planning subarea. Some of the Bulletin's regional water management evaluations discuss information at the PSA level. The smallest study unit used by the Department is the detailed analysis unit. California is divided into 278 DAUs. Most of the Department's Bulletin 160 analyses begin at the DAU level, and the results are aggregated into hydrologic regions for presentation.



*Agreements reached in the 1994 Bay-Delta Accord were widely hailed as a truce in California's water wars. The approach taken in the Bay-Delta exemplifies some hallmarks of today's water management activities—increased participation by local governments and other stakeholders in statewide water management issues, and significant efforts to carry out ecosystem restoration actions.*

## Changes Since the Last California Water Plan Update

The last *California Water Plan* update, Bulletin 160-93, was published in 1994 and used 1990-level information to represent base year water supply and demand conditions. At that time, California had recently emerged from the six-year drought and Bay-Delta issues were in a state of flux. Bulletin 160-98 uses 1995-level information to represent base year conditions, including new (interim) Bay-Delta standards.

Changes in Sacramento-San Joaquin River Delta conditions are a major difference between the two bulletins. Bulletin 160-93 was based on State Water Resources Control Board Decision 1485 regulatory conditions in the Delta, and used a range of 1 to 3 maf for unspecified future environmental water needs—a range that reflected uncertainties associated with Bay-Delta water needs and Endangered Species Act implementation. Bulletin 160-98 uses SWRCB's Order WR 95-6 as the base condition for Bay-Delta operations, and describes proposed CALFED actions for the Bay-Delta.

Bulletin 160-93 was the first *California Water Plan* update to examine the demand/supply balance for drought water years as well as for average water years, a response to water shortages experienced during the then-recent drought. Bulletin 160-98 retains the drought year analysis and also considers the other end of the hydrologic spectrum—flooding. Traditionally, water supply has been the dominant focus of the water plan updates. In response to the January 1997 flooding in Northern and Central California, Bulletin 160-98 highlights common areas in water supply and flood control planning and operations and emphasizes the benefits of multipurpose facilities.

## Changes in Response to Bulletin 160-93 Public Comments

Other changes between the two reports resulted from public comments on Bulletin 160-93. The dominant public comment on Bulletin 160-93 was that it should show how to reduce the gap between existing supplies and future demands, in addition to making supply and demand forecasts. Bulletin 160-98 addresses that comment by presenting a compilation of local agencies' planning efforts together with potential water management options that are statewide in scope. Local agencies' plans form the base for this effort, since it is local water purveyors who have the

FIGURE ES1-2.  
**California's Hydrologic Regions**



## California's Hydrologic Regions

|                          |  |
|--------------------------|--|
| <b>North Coast</b>       | Klamath River and Lost River Basins, and all basins draining into the Pacific Ocean from the Oregon stateline southerly through the Russian River Basin.   |
| <b>San Francisco Bay</b> | Basins draining into San Francisco, San Pablo, and Suisun Bays, and into Sacramento River downstream from Collinsville; western Contra Costa County; and basins directly tributary to the Pacific Ocean below the Russian River watershed to the southern boundary of the Pescadero Creek Basin. |
| <b>Central Coast</b>     | Basins draining into the Pacific Ocean below the Pescadero Creek watershed to the southeastern boundary of Rincon Creek Basin in western Ventura County.   |
| <b>South Coast</b>       | Basins draining into the Pacific Ocean from the southeastern boundary of Rincon Creek Basin to the Mexican boundary.   |
| <b>Sacramento River</b>  | Basins draining into the Sacramento River system in the Central Valley (including the Pit River drainage), from the Oregon border south through the American River drainage basin.   |
| <b>San Joaquin River</b> | Basins draining into the San Joaquin River system, from the Cosumnes River basin on the north through the southern boundary of the San Joaquin River watershed.  |
| <b>Tulare Lake</b>       | The closed drainage basin at the south end of the San Joaquin Valley, south of the San Joaquin River watershed, encompassing basins draining to Kern Lakebed, Tulare Lakebed, and Buena Vista Lakebed.   |
| <b>North Lahontan</b>    | Basins east of the Sierra Nevada crest, and west of the Nevada stateline, from the Oregon border south to the southern boundary of the Walker River watershed.   |
| <b>South Lahontan</b>    | The closed drainage basins east of the Sierra Nevada crest, south of the Walker River watershed, northeast of the Transverse Ranges, north of the Colorado River Region. The main basins are the Owens and the Mojave River Basins.  |
| <b>Colorado River</b>    | Basins south and east of the South Coast and South Lahontan regions; areas that drain into the Colorado River, the Salton Sea, and other closed basins north of the Mexican border.  |

ultimate responsibility for meeting their service areas' needs.

Bulletin 160-98 excludes groundwater overdraft from the Bulletin's base year water supply estimate and is therefore the first water plan update to show an average water year shortage in its base year. (Both of the bulletins excluded future groundwater overdraft from future water supply estimates.) About 1.5 maf of the 1.6 maf base year shortage is attributable to groundwater overdraft.

Finally, Bulletin 160-98 uses applied water data, rather than the net water amounts historically used in the water plan series. This change was made in response to public comments that net water data were more difficult to understand than applied water data. This concept is explained in Chapter ES3.

## Changes in Future Demand/Shortage Forecasts

Bulletin 160-93 used a planning horizon of 1990-2020. Bulletin 160-98 uses a planning horizon of 1995-2020. Bulletin 160-98 uses the 2020 planning horizon because no major data changes occurred between the two reports that would justify extending the planning horizon. Urban water demands depend heavily on population forecasts—the next U.S. Census will not be conducted until 2000.

The water plan series uses population forecasts from the Department of Finance. DOF reduced its 2020 forecast for California in the period between Bulletin 160-93 and Bulletin 160-98. The reduction reflects the impacts of the economic recession in California in the early 1990s. California experienced a record negative net domestic migration then, as more



people moved out of the State than moved in. This reduction in the population forecast translates to a reduction in forecasted urban water use in Bulletin 160-98.

The 2020 forecasted agricultural water demands increased from Bulletin 160-93 to Bulletin 160-98, even though the forecasted crop acreage decreased slightly. This increase resulted from elimination of the “other” category of water use shown in Bulletin 160-93, which included conveyance losses. For Bulletin 160-98, water in the “other” category was reallocated back to the major water use categories to simplify information presentation. Most of the conveyance losses are associated with agricultural water use. Combining the “other” category into the major water use categories most affected the agricultural water demand forecast. When conveyance losses are factored out of the Bulletin 160-98 forecast, agricultural water use decreases between Bulletin 160-93 and Bulletin 160-98.

Bulletin 160-93 was the first water plan update to quantify environmental water use, recognizing the importance of the water that is dedicated to environmental purposes for maintaining those resources and that this water is unavailable for future development for other purposes. As illustrated earlier, the environmental sector is California’s largest water using sector. Bulletin 160-98 uses the same definition and quantification procedure for environmental water use as did Bulletin 160-93.

The 2020 environmental water demand forecast increased substantially from Bulletin 160-93 to Bulletin 160-98. This increase results from implementation of the Bay-Delta Accord, inclusion of additional wild and scenic river flows, and increased instream flow requirements.

The shortage shown in Bulletin 160-98 is similar in magnitude to the low end of the shortage range reported in Bulletin 160-93. The treatment of forecasted Bay-Delta environmental water demands accounts for much of the difference. The range of potential future environmental water demands of 1 to 3 maf used in Bulletin 160-93 was added to that Bulletin’s base environmental water demand forecast, rather than being evaluated through operations studies, because Bay-Delta regulatory assumptions could not be determined then. This conservative approach yielded higher demands than operations studies would have provided.

## Preparation of Bulletin 160-98

Although the water plan updates are published

only every five years, the Department continuously compiles and analyzes the annual data used to prepare them. After publication of Bulletin 160-93 in 1994, the remainder of that year was devoted to finishing data evaluation deferred during the Bulletin’s production. Work on Bulletin 160-98 began in 1995. A citizens’ advisory committee with more than 30 members, representing a wide range of interests, was established to assist the Department in its preparation of the next water plan update. The advisory committee met with Department staff 17 times during Bulletin 160-98 preparation, and in August 1997 reviewed an administrative draft that preceded release of the public review draft at the end of January 1998. The review period for the public draft extended through mid-April 1998, during which time public meetings were held and presentations were made to interested parties. The draft was also made available on the World Wide Web. Over 4,000 copies of the public review draft were distributed.

## Public Comments on Draft

The Department received over 200 comment letters on the draft and additional comments from public meetings. Many comments were provided by local agencies whose facilities and projects are described in the public draft, and dealt with edits or corrections regarding those facilities or projects. Another major class of comments dealt with policy, conceptual, or analytical subjects. Many of these comments were influenced by discussions taking place in the CALFED Bay-Delta program and reflected the commenters’ positions on CALFED issues. For example, proponents of CALFED’s no conveyance improvements alternative generally expressed opposition to Bulletin 160-98’s exclusion of groundwater overdraft as a supply, because this approach increases overall statewide shortages. The Department received positive public comments on Bulletin 160-93 when it excluded groundwater overdraft as a supply for the first time, and also received positive comments on its treatment of overdraft for Bulletin 160-98. Often, public comments conflicted with one another. For example, environmental organizations frequently stated that the Bulletin should include more future water conservation, while water purveyors frequently stated that levels assumed in the Bulletin were overly optimistic. Some comments suggested that the Bulletin’s future water demands could be reduced by raising water prices, while others felt that the forecasted demands were too low and did not

take into account future needs of California's population and agricultural economy. Likewise, some comments expressed philosophical opposition to constructing more reservoirs in California, while others emphasized the need for more storage and flood control reservoirs. The Department considered these comments in the context of the Bulletin's goal of accurately reflecting actions that water purveyors statewide would be reasonably likely to implement by year 2020.

Some comments suggested that Bulletin 160-98 (or the Department, or the State of California) advocate or express a vision on a variety of subjects—including State-funded water supply development, sustainable development, nonpoint source pollution, flood control, food production security, mandatory water pricing, and greater use of desalting (by entities other than the commenter). Such an approach is outside the scope of the Department's water plan update series. The role of the Bulletin 160 series is to evaluate present and future water supplies and demands given current social/economic policies, and to evaluate progress in meeting California's future water needs. As appropriate, the Bulletin discusses how other factors such as flood control may relate to water supply planning.

To develop 2020-level conditions, the Department makes a fundamental assumption that today's conditions—facilities, programs, water use patterns, and other factors—are the basis for predicting the future. (And, as one commenter correctly pointed out, Bulletin 160-98 also assumes that California's climate will remain unchanged over the Bulletin's 25-year planning horizon.) This approach differs distinctly from the approach of establishing a desired future goal or vision, and then preparing a plan that would implement that goal or vision. Such a plan would require broad public acceptance that simply does not exist today.

Many of the advocacy or vision comments described above are also not within the Department's jurisdiction or the jurisdiction of other State agencies. For example, the Department's role in developing water supply for local agencies is limited to fulfilling its State Water Project contractual obligations. (The Department may provide financial assistance to local agencies for various water management programs as authorized under bond measures enacted by the Legislature and approved by the voters.) The Department has no regulatory authority to mandate how local water agencies price their water supplies, or to require that local agencies adopt one type of water manage-

ment option over another. Comments such as those suggesting that the Department plan for control of nonpoint source pollution or food production address the jurisdictional areas of other State agencies.

The subject of flood control merits special mention because of the direct relationship between operation of water supply projects and flood control projects. The purpose of the water plan update series is to evaluate water supplies, but those supplies can be affected by flood control actions such as increasing the amount of reservoir storage dedicated to flood control purposes. With memories of the disastrous January 1997 floods still fresh in people's minds, some commenters recommended that Bulletin 160-98 devote more attention to flood control needs, such as floodplain mapping programs, that are not directly related to water supply considerations. The 1997 *Final Report of the Governor's Flood Emergency Action Team* describes recommended actions to be taken based on the damages experienced in January 1997. Sections of that report are referenced throughout the Bulletin. Bulletin 160-98 emphasizes the interaction between water supply and flood control planning, and points out the benefits associated with multipurpose water projects.

As discussed in the following section, the Department received a number of comments requesting that Bulletin 160-98 quantify future water supply uncertainties associated with ongoing programs or regulatory actions, such as the CALFED Bay-Delta program, Federal Energy Regulatory Commission hydroelectric plant relicensing, and Endangered Species Act listings. Text has been added that quantifies those actions for which data are available.

The Department received some comments that could not be incorporated in Bulletin 160-98 because they suggested substantial changes in the scope or content of the Bulletin that could not be addressed before the Bulletin's due date to the Legislature, or suggested changes for the next update of the water plan. The scope of Bulletin 160-98 was established in coordination with the Bulletin's advisory committee in 1995, just as the scope of the next plan update (five years hence) will be established early in the process of preparing that update. The Department will consider these long-term comments when work begins on the next update.

### ***Works in Progress and Uncertainties***

The descriptions of major California water management activities provided in the Bulletin are generally



current through July 1998. There are several pending activities that could be characterized as works in progress, including the CALFED Bay-Delta program and Colorado River water use discussions. For programs such as these, the Bulletin describes their current status and potential impacts, if known, on future water supplies. There are uncertainties associated with the outcomes of these activities, just as there are with any process that is evaluated in mid-course.

As noted at the beginning of this chapter, each water plan update focused on issues or concerns of special interest at the time of its publication. As an example of this focus, Bulletin 160-83 was the last water plan update to review water use for hydropower generation. No major changes have occurred since the late 1970s/early 1980s, when high energy prices and favorable tax treatment for renewable energy spurred a boom in small hydropower development. Today, uncertainties about water supply and water use associated with hydropower production are increasing, with the 1998 initiation of deregulation for California investor-owned power utilities and the prospect of FERC relicensing of several powerplants on major Sierra Nevada rivers between 2000 and 2010. Although there is presently little information available on which to

base forecasts of resultant changes in water supplies, more information is likely to be available for the next water plan update.

Colorado River interstate issues are a new addition to a statewide water picture largely dominated by Delta and Central Valley Project Improvement Act issues in the recent past. Achieving a solution to California's need to reduce its use of Colorado River water to the State's basic apportionment (a reduction of as much as 900 taf from historical uses) requires consensus among California's local agencies that use the river's water, as well as concurrence in the plan by the other basin states.

### ***Presentation of Data in Bulletin 160-98***

Water budget and related data are tabulated by hydrologic region throughout the Bulletin. The statewide totals in these tables are generally presented as rounded values. As a result, individual table entries will not necessarily sum exactly to the rounded totals.

In the Chapter ES5 water budget appendices, regional water use/supply totals and shortages are not rounded. Individual table entries may not sum exactly to the reported totals due to rounding of individual entries for presentation purposes.